FORENSICS

Read the General Rules in the manuals and on www.soinc.org as they apply to every event.

1. **DESCRIPTION**: Given a scenario and some possible suspects, students will perform a series of tests. These tests, along with other evidence or test results will be used to solve a crime.

A TEAM OF UP TO: 2 **EYE PROTECTION**: #4 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**

a. **Students** may bring only these items:

i. test tubes and test tube holders or any devices in which they can perform the tests
ii. droppers
iii. funnel(s) &/or filter paper
iv. pH or litmus paper
v. spatulas, plastic spoons, &/or stirring rods,
vi. 9 volt conductivity tester (no testers will be allowed that run on AC current)
vii. thermometer
viii. flame test equipment (nichrome wire, cobalt blue glass, etc.)
ix. slides & cover slips

x. hand lens
xi. writing instruments
xii. a pencil and ruler (for chromatograms)
xiii. paper towels
xiv. metal tongs
xv. Each team may bring one 8.5" x 11" two-sided page of notes containing information in any form from any source.
xvi. a non-programmable calculator

Note: Students not bringing these items will be at a disadvantage. The event supervisor will not provide them.

b. **Supervisor will provide**:

i. iodine reagent (I_2 dissolved in KI solution)
ii. 2M HCl
iii. 2M NaOH
iv. Benedict's solution
v. a hot water bath
vi. a Bunsen burner or equivalent BTU heat source to perform flame tests
vii. a waste container
viii. chromatography materials - e.g., beakers, Petri dishes, etc.
ix. a wash bottle with distilled water

The supervisor may provide:

x. other equipment (e.g., a microscope, probes, etc.) or
xi. **candle & matches if fibers given, or**
xii. **differential density solutions or other method of determining density of polymers if plastics given or**
xiii. reagents to perform other tests.

c. **Safety Requirements**: Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see http://soinc.org), pants or skirts that cover the legs to the ankles, **and** a **long** sleeved shirt **that reaches the wrists, and** a chemical apron or a lab coat that reaches the knees. **Chemical** gloves are optional. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) will be disqualified from the event.

3. **THE COMPETITION:**

Level	# Part a samples	# Part b samples	Part c chromatograms	Part d	Part e
Regional	3-8	5-9	1 type + Mass Spectra	1-2 topics	Required
State	6-10	6-12	1-2 types + Mass Spectra	1-3 topics	Required
National	8-12	10-18	1-3 types + Mass Spectra	3-5 topics	Required

a. **Qualitative Analysis**: Substances to identify: sodium acetate, sodium chloride, sodium hydrogen carbonate, sodium carbonate, lithium chloride, potassium chloride, calcium nitrate, calcium sulfate, calcium carbonate, cornstarch, glucose, sucrose, magnesium sulfate, boric acid, and ammonium chloride (there will be no mixtures). All teams will have the same set of solids to identify.

b. **Polymers**: Students may be asked to identify:
   i. PETE, HDPE, non-expanded PS, LDPE, PP, PVC, PMMA, PC (Students may not perform any burn tests on these polymers. Burn test results on these plastics may be provided by the event supervisor).
   ii. cotton, wool, silk, linen, nylon, spandex, polyester (Burn tests will be permitted on the fibers)
   iii. human, dog, cat, bat, and horse hair. (Students will need to know hair structure including medulla, cortex, cuticle, and root.)

c. **Chromatography/Spectroscopy**: Students will be expected to separate components using paper chromatography, TLC, and/or analyze mass spectra. Students may be expected to measure R_fs.

d. **Crime Scene Physical Evidence**:
   i. **Fingerprint Analysis:** Students may be expected to know the 8 NCIC classifications (arch, tented arch, radial loop, ulnar loop, plain whorl, central pocket whorl, accidental, and double loop). Students should also be familiar with the common fingerprint development techniques of dusting, iodine fuming, ninhydrin, and cyanoacrylate fuming. Students should understand terminology such as bifurcation, ridges, island, enclosure, loop, whorl, and arch. Students should be able to answer questions about skin layers and how fingerprints are formed. Students may be asked questions on the different methods of detecting fingerprints and the chemistry behind each of these methods.
   ii. **DNA**: Students may be asked to compare DNA chromatograms/electropherograms from materials found at the scene to those of the suspects. Students will be expected to know how DNA is copied. See http://nobelprize.org/educational_games/chemistry/pcr/index.html
   iii. **Glass analysis**: Students may be asked to use index of refraction to determine the type of a glass found broken at a crime scene. They may be asked to analyze which hole or fractures occurred before others based on a piece of glass available for examination or a picture of a piece of glass.
   iv. **Entomology**: Students may be asked to identify how long an animal has been dead based on the type of insects found on the body at the scene.
   v. **Spatters**: Students may be asked to analyze actual spatters or photographs of spatters to determine the angle and velocity with which the liquid approached the solid object bearing the spatter & the spatter origin direction.
   vi. **Seeds and Pollen**: Students may be asked to compare pictures of seeds/pollen found at the scene with either seeds/pollen found on the suspects or seeds/pollen from different country regions.
   vii. **Tracks and Soil**: Students may be asked to match tire tracks or footprints found at the scene to tires or shoes of the suspects. Students may be given the composition of soil found at the scene or on the suspects and asked to determine if this implicates any of the suspects.
   viii. **Blood:** Students may be asked to identify the ABO blood type using artificial blood (event supervisor required to provide instructions on how the typing system works) or students may be asked to identify if blood sample, either prepared microscope slide or pictures of microscope slide is human, avian, mammalian, or reptilian/amphibian.
   ix. **Bullet striations:** Students may be asked to match the striations on bullets or casings found at the crime scene and fired from a given gun.

e. **Analysis of the Crime**: Students will be asked to write an analysis of the crime scene explaining not only which pieces of evidence implicate which suspect and why the suspect(s) was (were) chosen as the culprit(s), but also why the other suspects were not chosen. They will also answer any other crime scene analysis questions posed by the event supervisor.

f. The collected evidence and other data given could be used in a mock crime scene.

4. **SCORING**: Team with the highest score wins. Time will not be used for scoring. The score will be composed of the following elements (percentages given are approximate):
   a. Part 3.a. 20%, Part 3.b. 20%, Part 3.c. 15%, Part 3.d. 15%, and 3.e. 30%.
   b. Tiebreaker: Ties will be broken by the highest score on the analysis of the crime scene, which includes the reasons why certain suspects have been eliminated or others remain in the pool of possible criminals.
   c. A 10% penalty may be given if the area is not cleaned up as designated by the event supervisor.

Recommended Resources: All reference and training resources including the **Forensics CD** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

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